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(54) Keksinnön nimitys - Uppfinningens benämning

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Övervakning av nätelement

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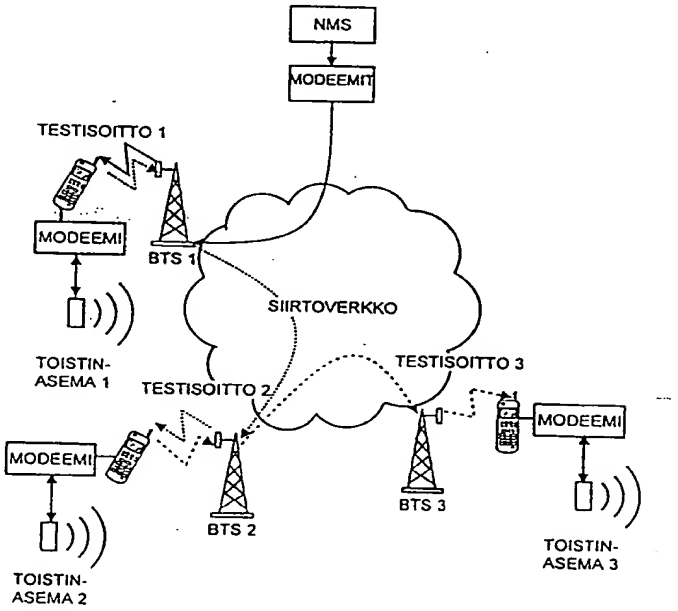
Keksinnön perusajatuksena on hyödyntää matkapuhelinta ja puhelinta ohjaavaa ohjauslaitetta, jotka on jo asennettu radioverkkoon. Tällaisia puhelimia ovat esimerkiksi radiotoistinasemiin asennetut puhelimet. Keksinnön mukaisesti radiotoistinaseman matkapuhelinta käytetään puhelujen vastaanottamiseen ja soittamiseen. Radiotoistinaseman ohjauslaite asetetaan soittamaan testisoitto toiselle radiotoistinasemalle vastauksena vastaanottamaansa testisoittoon. Nämä peräkkäiset testisoitot muodostavat testiketjun. Toistinasema voi kuulua useisiin testiketjuihin. Tässä toteutusmuodossa useaan testiketjuun kuuluvalle toistinasemalle annetaan luettelo puhelinnumeroista eli jokaisen ketjun radiotoistinaseman numero. Ketjut tunnistetaan puhelinnumeroiden tai ketjussa edeltävän toistinaseman muiden tunnusten perusteella.



Jatkuu seur. sivulla
Forts. nästa sida

Network element monitoring

Field of the invention

This invention relates to the monitoring of network elements in a radio telecommunication network.

Background of the invention

Network elements relating to a known wireless telecommunication network and the connections between the network elements are presented in Figure 1. The network used as an example in this application is according to the GSM standard. The solid lines in the figure illustrate connections comprising both signaling and traffic connections. The dashed lines correspond to pure signaling connections.

The network comprises Mobile Stations MS, radio repeaters, Base Transceiver Stations (BTS1-BTS6), Base Station Controllers (BSC1, BSC2) and Mobile Switching Stations (MSCA, MSCB). The mobile switching stations are connected to their corresponding Visitor Locations Registers VLR. Additionally, the network comprises a Home Location Register HLR, and a Network Management System NMS.

The mobile stations MS are capable of establishing connections with the base stations BTS. The connection can be established directly between the MS and the BTS or using a radio repeater which amplifies the signals of the mobile and the base station. As an example, the signal sent by the mobile station MS shown in Figure 1 is first amplified by the radio repeater Repeater 1 and then received by BTS4. BTS4 sends the information included in the signal via the base station controller BSC2 to the mobile switching center MSCA. Depending on the location of the called subscriber, MSCA switches the calls either back to the base station controllers BSC1 or BSC2 controlled by MSCA, to other mobile switching centers, such as MSCB or to other telecommunication networks, such as PSTN (Public Switched Telephone Network) or ISDN (Integrated Services Digital Network).

The network management system NMS is used to collect information such as the traffic situation of the network and to load configuration information and programs over to other network elements. A plurality of network management systems can be used in one network. For example, the mobile switching centers MSC can be controlled by one NMS, the base sta-

tion controllers and the base stations by another NMS, and the radio repeaters by a third NMS. These different management systems can also be connected to each other for the exchange of information.

The purpose of radio repeaters is shown in Figure 2. The basic task of the repeater is to amplify the signal of the base station in places where the direct signal from the base station is not sufficiently strong. The repeater comprises a receiver, an amplifier, and a transmitter. Basically, repeaters can be unidirectional or bidirectional, i.e. they can amplify the signal in only one direction (from the base station to the mobile station, for example) or in both directions (i.e. both from base station to the mobile station and vice versus). Usually, bidirectional repeaters are used. Radio repeaters can be used for amplifying the indoor signal in an urban environment, for example.

To be able to control the network, knowledge concerning the state of the network has to be gathered. Error situations, for example, have a major influence on the performance of the network and must be taken into account when justifying the network parameters and corrected as soon as possible. Therefore, the network elements have to be monitored. Here, the monitoring of base stations and radio repeaters is studied.

The base station is equipped with a test phone for monitoring the function of the base station. The base station is tested by establishing test calls according to instructions given by the network management system. If errors occur, the base station sends the network management system an alarm using a special channel for management messages.

A modem connection is used for monitoring radio repeaters. The radio repeaters are connected to the network management system by means of a modem connection and a mobile phone which is connected to the mobile telecommunication system of the repeater. Such a system is shown in Figure 3. In the figure, also the test phone STM (Site Test Measurement) at the base station site is shown. The mobile phone MS at the repeater listens to the signal of the base station BTS. When a need arises, a modem connection between the repeater and the network management system is established via the mobile phone. Through the modem connection, the network management system sends to the radio repeaters configuration parameters, such as the radio channels to be used, the transmission power, the phone number of the modem of the management system, etc.. Correspondingly, the

radio repeaters send the management system alarms indicating error situations and faults and acknowledgments of the configuration messages received from the NMS.

The establishment of a connection between the NMS and a repeater can be initiated by either the management system NMS or the repeater. The NMS initiates a connection with a repeater in order to change or check a configuration parameter of a repeater. In order to contact the repeater, the modem of the network management system NMS establishes a connection with the modem of the repeater via the transmission network. This connection is established when the transmission modem identifies a free modem line in the transmission network. The identifier of the modem is stored in the network management system. When the transmission network is a normal telephone network, the identification is the telephone number of the modem.

The repeaters contact the NMS to send alarms. This is done by using the identification of the modem of the management system stored by the repeater.

To be sure that the repeater can send the management system alarms when necessary, the management system establishes test calls to the modems of the repeaters it controls. This procedure, which is called heartbeat control of the repeater, is shown in Figure 4. In the figure, the network management system NMS establishes test modem calls to the repeaters Repeater 1, Repeater 2 and Repeater 3. First, a test call to Repeater 1 is established using the MSISDN number (Mobile Subscriber Integrated Services Digital Network number) of the mobile phone in the repeater. Second, a test call is made to Repeater 2. Third, a test call is made to Repeater 3.

The arrangement described above has several severe problems. In order to monitor the function of a base station, a test phone and its control logics have to be implemented in the base station. Due to the low volume of production compared to the volumes of mobile phones, for example, the test phones are rather expensive.

For monitoring radio repeaters using heartbeat control according to prior art, the network management system has to establish a test call to every repeater it controls regularly. This method is slow and reserves a lot of capacity in the network management system. In order to reduce the time delay between the test calls, the number of radio repeaters controlled by one

network management system has to be reduced. Therefore, the need for heartbeat control increases the number of network management system needed, and thus the expenses of the network operator.

The objective of the present invention is to solve the above problems. This objective is achieved using the method and apparatus defined in the independent claim.

Summary of the invention

The basic idea of the invention is to exploit the mobile phone and the control apparatus controlling the phone already installed in the radio network. An example of such phones are the phones installed in the radio repeaters. According to the invention, the mobile phone of the radio repeater is used to both receive and make test calls. The controlling apparatus in the radio repeater is configured to make a test call to another repeater in response to having received a test call. These consecutive test calls form a test chain.

A repeater can belong to a plurality of test chains. In this embodiment, the repeater belonging to a plurality of test chains is given a list of test phone numbers, i.e. a phone number of a radio repeater for every chain. The chains are distinguished by phone numbers or other identifiers of the preceding repeater in the chain.

In the case of a successful test call between two radio repeaters, both the base station of the calling repeater and the base station of the called repeater are in working order. Additionally, both the mobile phones and the modems of both of the repeaters are in working order, and the repeaters can thus contact the network management system if necessary for alarm purposes.

If the test call is unsuccessful, but the preceding test call in the chain has been successful, it may be concluded that either the base station or the mobile phone of the called repeater is not in working order. If calls to different repeaters of the same base station are unsuccessful, it may be concluded that the error lies in the base station.

The mobile phone and its control apparatus in the repeater are an independent unit. Therefore, an error situation in the repeater does not break the test chain.

The test chain can be configured by sending directly from the network management system to every repeater of the test chain the necessary information, such as the identity of the next repeater in the chain. As an alternative, the management system can send information concerning the whole chain to the first repeater of the chain. This information is then forwarded through the chain in the test calls between the repeaters. To monitor the test procedure, the management system can in addition request one or more repeaters to send the management system feedback concerning the test calls.

In addition to radio repeaters, other mobile phones readily installed in the network can be used to monitor the base stations.

Brief description of the figures

The invention is described more closely with reference to the accompanying schematic drawings, in which

Figure 1 shows the structure of a mobile telecommunication network;
Figure 2 shows the purpose of radio repeaters;
Figure 3 shows a method of controlling radio repeaters;
Figure 4 shows the principle of heartbeat control of radio repeaters;
Figure 5 shows a test chain;
Figure 6 shows the coverage area of the network elements monitored;
Figure 7 shows two test chains; and
Figures 8A and 8B show apparatus for using test chains.

Detailed description of the invention

In this invention, the problems of prior art are solved by exploiting the mobile phone and the apparatus controlling it, both already installed in the radio repeaters. The repeaters are ordered into test chains. The repeater receives a test call from the preceding repeater in the test chain, and, in response to that, makes a test call to the next repeater in the chain.

A test chain according to the invention is shown in Figure 5. The network management system NMS initiates the procedure by making a test call to Repeater 1 using the MSISDN number of the mobile in the repeater. The test call is routed through the transmission network, which in this case is the GSM network of the repeater. The mobile phone of the repeater is

paged, and the mobile hears the page when listening to the signal sent by the base station BTS1. Having heard the page, the mobile requests the BTS for a channel, and the call is established. If the call is successful, it can be concluded that both BTS1 and the mobile phone and its control apparatus in Repeater 1 are in working order. If the call can not be established, the network management system concludes that an error situation has occurred either in the mobile phone of the repeater or in the base station BTS1. If several radio repeaters are installed to amplify the signal of BTS1, the NMS can, in response to an unsuccessful test call to the mobile phone of the first repeater amplifying the signal of BTS1, make a test call to another radio repeater of the same base station. If this test call is successful, it can be deducted that the error situation is in the mobile phone or the control unit of the mobile phone of the first repeater.

If the phone of the repeater is able to detect signals from a plurality of base stations, a test call destined to that phone can be successful even if the primary base station of the repeater is not working. However, the base stations include their identity information BSIC (Base Station Identity Code) into their signal. Thus, the phone can identify the base station used in the test call. If the phone can not hear a signal from the base station it is primarily connected to and thus can not receive a test call using that base station, it concludes that the base station is not working. The incoming test call can still be established using another base station whose signal is strong enough at the repeater's site. The control unit of the repeater's phone can then inform the network management system of the error situation in the primary base station of the repeater via the other base station.

Having received the call, the apparatus controlling the mobile phone in the repeater establishes a second test call to Repeater 2 according to instructions sent by the network management system. To establish the call, the mobile phone of Repeater 2 is paged. The mobile listens to the signal sent by its base station BTS2, and in response to hearing the page, request BTS2 for a channel. In response to the request, the call is established. If the call is successful, it can be concluded that BTS2 and the mobile phone and its control apparatus in Repeater 2 are in working order. If the call can not be established, the apparatus controlling the mobile phone in Repeater 1 sends the network management system an alarm indicating that the test call to Repeater 2 was unsuccessful. The management system then concludes

that an error situation has occurred either in the mobile phone of the repeater or in the base station BTS2. Again, if several radio repeaters are installed to amplify the signal of BTS1, another test call can be made to another radio repeater of the same base station in response to an unsuccessful test call to the mobile phone of the first repeater amplifying the signal of the base station. The second test call can be initiated by either the network management system or the radio repeater that made the first test call. If this second test call is successful, it can be deducted that the error situation is in the mobile phone or the control unit of the mobile phone of the first repeater.

Having received the test call from Repeater 1, the apparatus controlling Repeater 2 makes a test call to the next repeater in the test chain, i.e. Repeater 3. Again, the mobile phone of Repeater 3 is paged. The mobile listens to the signal sent by its base station BTS3, and in response to hearing the page, requests BTS3 for a channel. In response to having received the request in the base station, the call is established. If the call is successful, it can be concluded that BTS3 and the mobile phone and its control apparatus in Repeater 3 are in working order. If the call can not be established, the apparatus controlling the mobile phone in Repeater 2 sends the network management system an alarm indicating that the test call to Repeater 3 was unsuccessful. The management system then concludes that an error situation has occurred either in the mobile phone of the repeater or in the base station BTS 3.

Having received the test call from Repeater 2, the apparatus controlling Repeater 3 makes a test call to the next repeater in the test chain, etc. The chains can be closed, thus keeping the monitoring procedure active all the time. In this case, the control apparatus of the mobile phones in the repeaters is advantageously arranged to wait for a predefined delay after having received a test call before making a test call to the next repeater in the test chain. The time difference between test calls to a repeater can be set to an optimum value by means of the predefined delay, thus making the procedure efficient while avoiding unnecessary use of radio resources in the network.

As shown in Figure 5, the NMS only has to make one test call to get all the base stations and the mobile phones in the repeaters of the test chain tested. Therefore, the heartbeat monitoring of the repeaters does not limit the number of repeaters controlled by a management system.

The geographical coverage area of the network elements that are monitored using the test chain is shown in Figure 6. The monitored coverage area is shown as the slashed area in the figure. A successful test call from the network management system to repeater R1 indicates that the operation of BTS1 and repeater R1 is reliable. It can thus be assumed that the network is in operating mode in the coverage area of BTS 1, shown as a hexagon, and in the coverage area of the repeater R1, shown as a triangle.

A successful test call from repeater R1 to repeater R2 indicates that the operation of BTS2 and repeater R2 is reliable. It can thus be assumed that the network is in operating mode in the coverage area of BTS 2, shown as a hexagon, and in the coverage area of the repeater R2, shown as a triangle.

Similarly, a successful test call from repeater R2 to repeater R3 indicates that the operation of BTS3 and repeater R3 is reliable. It can thus be assumed that the network is in operating mode in the coverage area of BTS 3, shown as a hexagon, and in the coverage area of the repeater R3, shown as a triangle.

One repeater can belong to a plurality of test chains. This embodiment is shown in Figure 7. In the figure, two test chains, A and B, are specified. Test chain A consists of repeaters R1, R2, R3, R4, R5 and R6. The test chain is initiated by a test call from the network management system NSM managing the radio repeaters. The test chain continues by R1 making a test call to R2, R2 making a test call to R3, and so on until R5 makes a test call to R6. In response to the test call received from R5, R6 initiates a test call to R1, and the procedure continues, i.e. the chain is closed. To obtain an optimal time difference between test calls, the repeaters or at least some of them are instructed to wait for a predefined period after having received a test call before making the test call to the next repeater in the test chain. The repeating test calls in the test chain can preferably be stopped by a stop message sent by the network management system to a repeater in the chain. In response having received the stop message, the repeater does not initiate a test call to the next repeater in the chain. Preferably, the stop message is sent to the first repeater in the chain.

Test chain B consists of repeaters R8, R7, R5, R4, R9 and R10. The chain is open, i.e. repeater R10 makes no test calls in response to having received a test call from R9. The NMS can thus control the time delay

between the test calls to an individual repeater, and no delay between the reception of a test call and the initiation of the next one is necessary. This test chain is initiated by making a test call to repeater R8 from the network management system managing the repeaters. In response to this call, R8 makes a test call to R7. Having received a test call from R8, R7 initiates a test call to R5, which belongs to both test chain A and test chain B.

In response to the test call received from R7, R5 makes a test call to R4. On the other hand, in response to having received a test call belonging to chain A from R4, it makes a test call to R6. Therefore, the test calls belonging to different test chains must be distinguished from each other. R5 must contain the information that

- if the test call received is from R4, then a test call is to be made to R6 after delay D, and
- if the test call received is from R7, then a test call is to be made to R4 immediately.

The test chains are planned in the network management system of the repeaters or in some other network management system. The unit controlling the mobile phone in the repeater is sent the phone number of the mobile phone to which the repeater is to make a test call. If the repeater belongs to a plurality of test chains the unit is sent a list of phone numbers, each number specifying the phone number of the next repeater in that particular chain. The list sent to repeater R5 in the example presented above can be as follows:

calling phone	calling repeater ID	phone to be called	repeater to be called	delay
040-257 7755	4	040-257 8888	6	2
040-257 6333	7	040-257 7755	4	0

The above table describes two test chains. The field "calling phone" includes the MSISDN number of the repeater that has made a test call to this repeater. The calling line identification presented in the incoming test call can then be used as a key when determining which test chain the received test call belongs to.

The field "calling repeater ID" includes the identity of the called repeater, and can be used as a key for identifying the test chain if the identity of the calling repeater is transferred to the called repeater during the test call.

The field "phone to be called" gives the MSISDN number of the next repeater in the test chain. It is the number to be dialed by the unit controlling the mobile phone when establishing a test call.

The field "repeater to be called" is the identity of the next repeater in the test chain. The field "delay" is the amount of delay before making the test call to the next repeater in the test chain. If no delay is indicated, the test call to the next repeater in the test chain is initiated immediately after having received a test call from the preceding repeater in the chain.

A list of the phone numbers of the next repeaters in the test chains can be transferred to the repeater directly from the network management system. Alternatively, the network management system can send the first repeater in the chain a list comprising the phone numbers of all the repeaters in the chain when putting a new chain into use. The first repeater adds the information concerning the new test chain into its memory and forwards the list to the second repeater in the chain. Again, the second repeater adds the information concerning the new chain into its memory and forwards the list onwards. This is continued till the last repeater in the chain.

The test chain is activated by a starting command sent by the repeater management system to the first repeater in the test chain. Having received the starting command, the unit controlling the mobile phone in the repeater reads the phone number of the next repeater in that particular chain. If there is a plurality of test chains, the identity of the activated test chain must also be transferred. If the test chain is closed, the chain can be activated by a starting command sent to any of the repeaters of the test chain.

Having received a test call from another identified repeater, the unit controlling the mobile phone of the repeater consults its memory in order to determine to which repeater it should now make a test call. The call is made, and if it is successful, the test chain continues. If the call is unsuccessful, the unit sends an alarm message to the network management system controlling the repeaters. One method of identifying the location of the observed malfunction in the alarm message is to identify the repeater to which the unsuccessful test call was made. The network management system can then determine the identity of the base station to which the repeater

is connected, and inform the personnel using the management system of the possible fault. Alternatively, if stored in the memory of the unit controlling the mobile phone, the identity of the base station can be directly specified in the alarm message.

Preferably, the network management system has means for checking if the test chain is running. This can be done by requesting one or more repeaters of the test chain to report the time of their last call or of their next test call, for example.

The reporting of successful test calls can also be implemented as a chain, i.e. a confirmation chain. In this embodiment, the management system informs a repeater in the test chain that all successful test calls must be reported to the NMS. This repeater becomes the first element of the confirmation chain. In response to a successful test call, the repeater sends the management system a message indicating that the test chain is running properly at that stage. Additionally, the repeater informs the next repeater in the test chain to send the management system a confirmation in response to a successful test call. This is continued until the request for confirmation arrives to a repeater that has been instructed not to continue the confirmation chain. This can be the first repeater of the confirmation chain, for example.

As yet another embodiment, only predefined repeaters are requested to pass the information that the test chain procedure has passed the repeater successfully. As an example of this embodiment, one of the repeaters of a closed test chain sends the network element notification whenever the test chain procedure passes the repeater. This procedure can be started by a starting command and stopped by a stopping command sent by the network management system.

If a plurality of repeaters in a chain, e.g. every third repeater of the chain, is to report the progress of the test procedure, the request can again be transferred together with the test calls. In this case, the first repeater informs the management system of the successful test call. Additionally, it sends the second repeater of the chain the instruction that every third repeater is to inform the management system of the progress of the test procedure, and a counter having the value 1. The second repeater forwards the information to the third repeater of the chain and increments the counter to 2. The third repeater forwards the information to the fourth repeater of the chain and increments the counter to 3. In response to receipt of the test call, the

fourth repeater sends the management system notification of the progress of the test chain. When continuing the chain by a test call to the next repeater, the fourth repeater again informs the next repeater that every third repeater is to inform the management system of the progress of the test procedure and sets the counter to value 1, etc.

The new means needed in the control unit controlling the mobile phone in a repeater, for example, are shown in Figure 8A. The mobile phone in the repeater can both receive and make calls. According to the invention, the radio repeater has

- means for receiving calls from other repeaters,
- a memory for storing the information concerning the test calls,
- decision means which is responsive to the memory and the means for receiving test calls and has the function of deciding if the a test call to the next repeater is to be made, and
- means responsive to the decision means for making test calls to other repeaters.

These functionalities can be easily implemented in the apparatus controlling the mobile phone. Additionally, if the test chains can be dynamically modified the repeater has means for receiving the information necessary, such as the phone number of the next repeater in the chain. Optionally, the test chain information can be forwarded to another repeater in the test chain using means for forwarding test chain information. These means may also include selection means for selecting the information relevant to the other radio repeater, in which case only the information thus selected is transferred to the other radio repeater.

The new means needed in the network management system NMS are shown in Figure 8B. In order to define and activate the test chains, the network management system controlling the repeaters has

- receiving means for receiving a manual input,
- generating means responsive to the receiving means for generating test chain information, and
- sending means responsive to the generating means for sending the test chain information to another network element such as a radio repeater.

In order to achieve optimum clarity about this application, all the network elements in the test chain examples are radio repeaters. However,

this is not essential for the invention, since the test chain may also include or only have other elements of a radio network comprised of a phone belonging to the system of the network and a control unit controlling the phone installed. Examples of such phones are phones used for the remote control of devices such as measurement devices. Also the test mobile phone of a base station can be included in the test chain.

Claims

1. A method of monitoring network elements in a radio telecommunication network,

the network comprising a network management system and a plurality of elements comprising a phone and control means for controlling the phone, the phone being capable of making connections to a base station of the network,

c h a r a c t e r i z e d in that

a test chain comprising a plurality of elements is established,

a test call to a element in the test chain is established, and in response to having received a test call,

the element makes a test call to the next element in the test chain.

2. A method according to claim 1, c h a r a c t e r i z e d in that at least one of the elements of the test chain is a radio repeater.

3. A method according to claim 1, c h a r a c t e r i z e d in that at least one of the elements of the test chain is a base station comprising a test mobile phone.

4. A method according to claim 1, c h a r a c t e r i z e d in that at least one of the elements of the test chain is a remote controlled device in the coverage area of the network.

5. A method according to claim 1, c h a r a c t e r i z e d in that the test chain is open.

6. A method according to claim 1, c h a r a c t e r i z e d in that the test chain is closed.

7. A method according to claim 1, c h a r a c t e r i z e d in that the a plurality of test chains are established.

8. A method according to claim 7, c h a r a c t e r i z e d in that at least one element belongs to a plurality of test chains.

9. A method according to claim 1, c h a r a c t e r i z e d in that the network management system sends all the elements belonging to a chain information about the next elements in the chain.

10. A method according to claim 1, c h a r a c t e r i z e d in that the network management system sends the first element of a chain information about the all the elements in the chain and their mutual order, and the element forwards this information to another element of the test chain.

11. A method according to claim 1, characterized in that in response to an unsuccessful call to the next element in the chain, the management system is sent an error message indicating the failure of the call.

12. A method according to claim 11, characterized in that in response to having received the error message, the network management system informs the personnel steering the network management system about a possible error in the base station the called phone establishes its connections with.

13. A method according to claim 11, characterized in that in response to having received the error message, the network management system informs the personnel steering the network management system about a possible error in the called phone.

14. A method according to claim 1, characterized in that the network management system initiates the test calls in a test chain by sending one of the elements of the test chain a starting command.

15. A method according to claim 1, characterized in that the network management system stops the test calls in a test chain by sending one of the elements of the test chain a stopping command.

16. A method according to claim 1, characterized in that the network management system requests an element to report a successful test call, and in response to a successful test call, the element contacts the network management system to inform the network management system that a test call was successful.

17. A method according to claim 16, characterized in that the reporting procedure is stopped by a stop message sent by the network management system.

18. A method according to claim 16, characterized in that

the network management system sends an element of a test chain a request for reports on the progress of the test procedure in the chain at predetermined intervals,

the element forwards this information to the next element in the test chain, and

the progress of the test procedure in the chain is reported to the network management system at predefined intervals.

19. A method according to claim 18, c h a r a c t e r i z e d in that every element of the test chain reports to the network management system the progress of the test procedure of the chain in response to a test call.

20. A radio repeater for a radio telecommunication network, the network comprising a network management system and a plurality of elements comprising a phone and control means for controlling the phone, the phone being capable of making connections to a base station of the network,

c h a r a c t e r i z e d in that the radio repeater has

means for receiving test calls,

a memory for storing the information concerning a test chain, the information comprising knowledge of the next element in the test chain,

decision means which is responsive to the memory and the means for receiving test calls and has the function of deciding whether a test call to the next element in the test chain is to be made, and

means responsive to the decision means for making test calls to other elements.

21. A radio repeater according to claim 20, c h a r a c t e r i z e d in that in addition the radio repeater has means for receiving information concerning the test chain.

22. A radio repeater according to claim 20, c h a r a c t e r i z e d in that in addition the radio repeater has means for forwarding information concerning the test chain to another radio repeater.

23. A control unit for controlling a phone in a radio telecommunication network, the network comprising a network management system and a plurality of elements comprising a phone and control means for controlling the phone, the phone being capable of making connections to a base station of the network,

c h a r a c t e r i z e d in that the control unit has

means for receiving calls,

a memory for storing the information concerning a test chain, the information comprising knowledge of the next element in the test chain,

decision means which is responsive to the memory and the means for receiving test calls and has the function of deciding whether a test call to another element is to be made, and

means responsive to the decision means for making test calls to other elements.

24. A control unit according to claim 23, c h a r a c t e r i z e d in that in addition the control unit has means for receiving and storing information concerning the test chain.

25. A control unit according to claim 23, c h a r a c t e r i z e d in that in addition the control unit has means for forwarding information concerning the test chain to another control unit of a phone.

26. A network management system for controlling the repeaters in a radio network,

the network comprising a network management system and a plurality of elements comprising a phone and control means for controlling the phone, the phone being capable of making connections to a base station of the network,

c h a r a c t e r i z e d in that the network management system has

receiving means for receiving a manual input,

generating means responsive to the receiving means for generating test chain information, the test chain comprising a plurality of elements, the elements of the chain being arranged to make a test call to the next element of the chain in response to having received a test call from the preceding element of the chain, and

sending means responsive to the generating means for sending the test chain information to an element.

(57) Abstract

The basic idea of the invention is to exploit the mobile phone and the control apparatus controlling the phone already installed in the radio network. An example of such phones are the phones installed in the radio repeaters. According to the invention, the mobile phone of the radio repeater is used to both receive and make test calls. The controlling apparatus in the radio repeater is configured to make a test call to another repeater in response to having received a test call. These consecutive test calls form a test chain. A repeater can belong to a plurality of test chains. In this embodiment, the repeater belonging to a plurality of test chains is given a list of test phone numbers, i.e. a phone number of a radio repeater for every chain. The chains are distinguished by phone numbers or other identifiers of the preceding repeater in the chain.

(Fig. 5.)

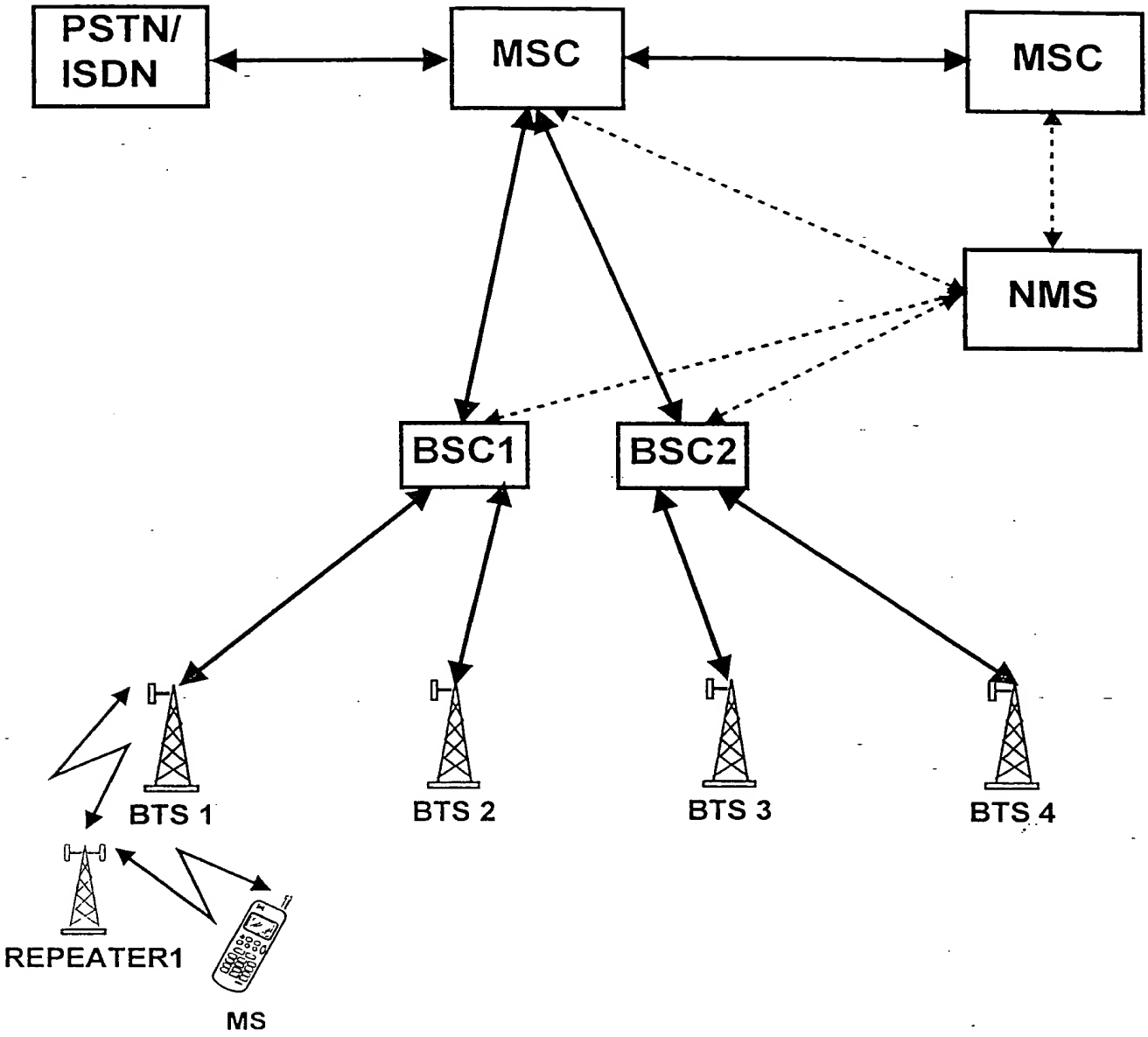

PSTN/
ISDN
MSC
MSC
NMS
BSC1
BSC2
BTS 1
BTS 2
BTS 3
BTS 4
REPEATER1
MS

FIG. 1.

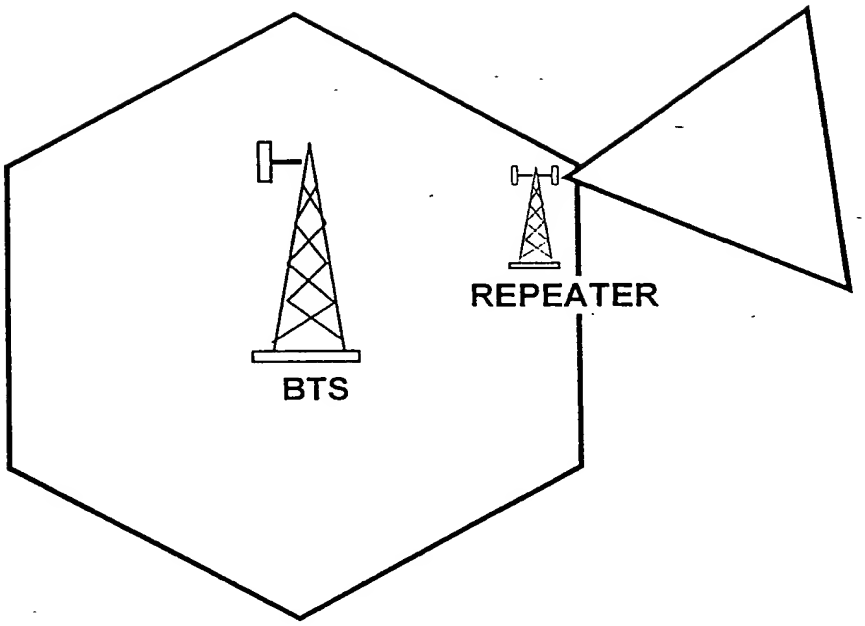


FIG. 2.

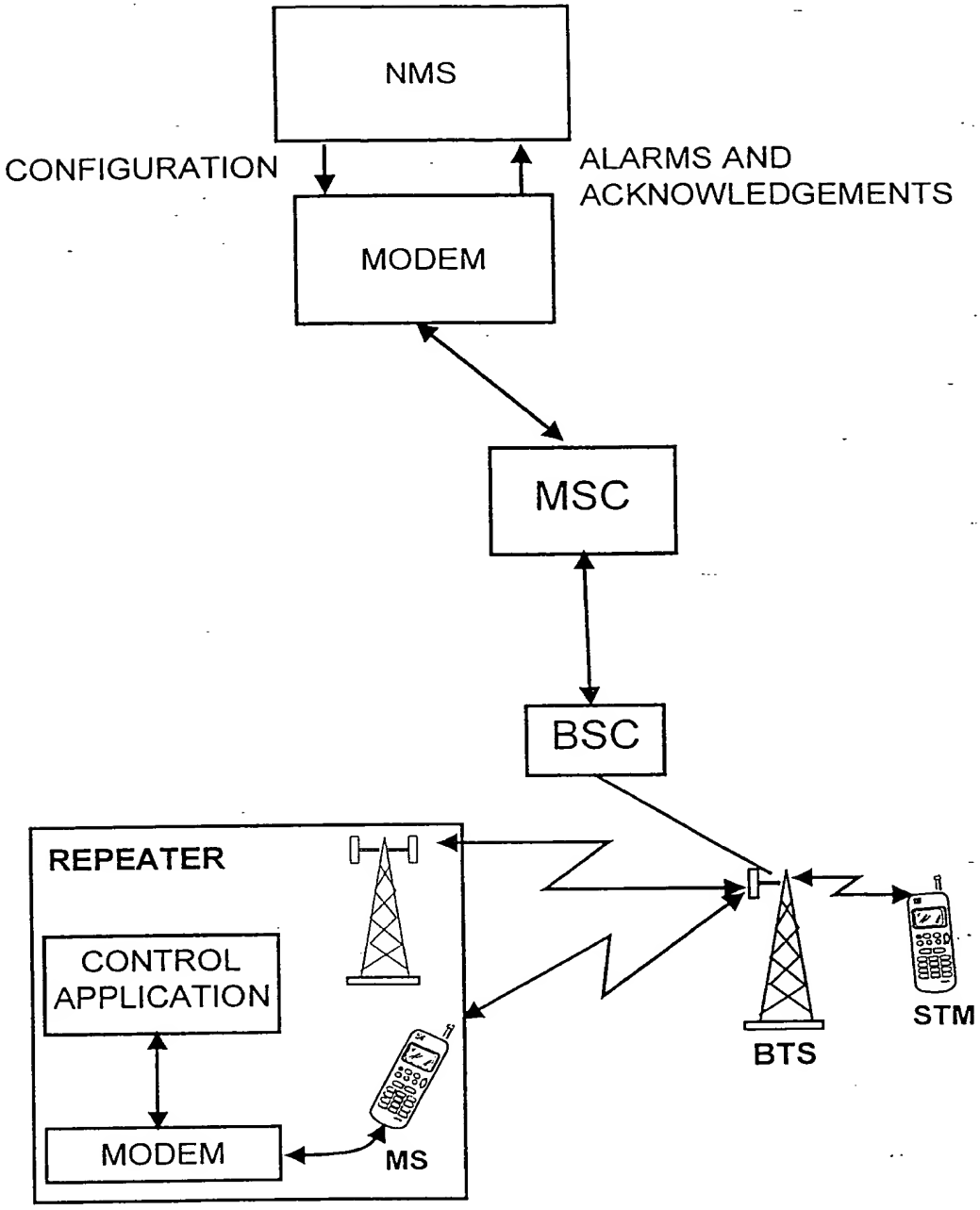

NMS
CONFIGURATION
ALARMS AND
ACKNOWLEDGEMENTS
MODEM
MSC
BSC
REPEATER
CONTROL
APPLICATION
MODEM
MS
BTS
STM

FIG. 3.

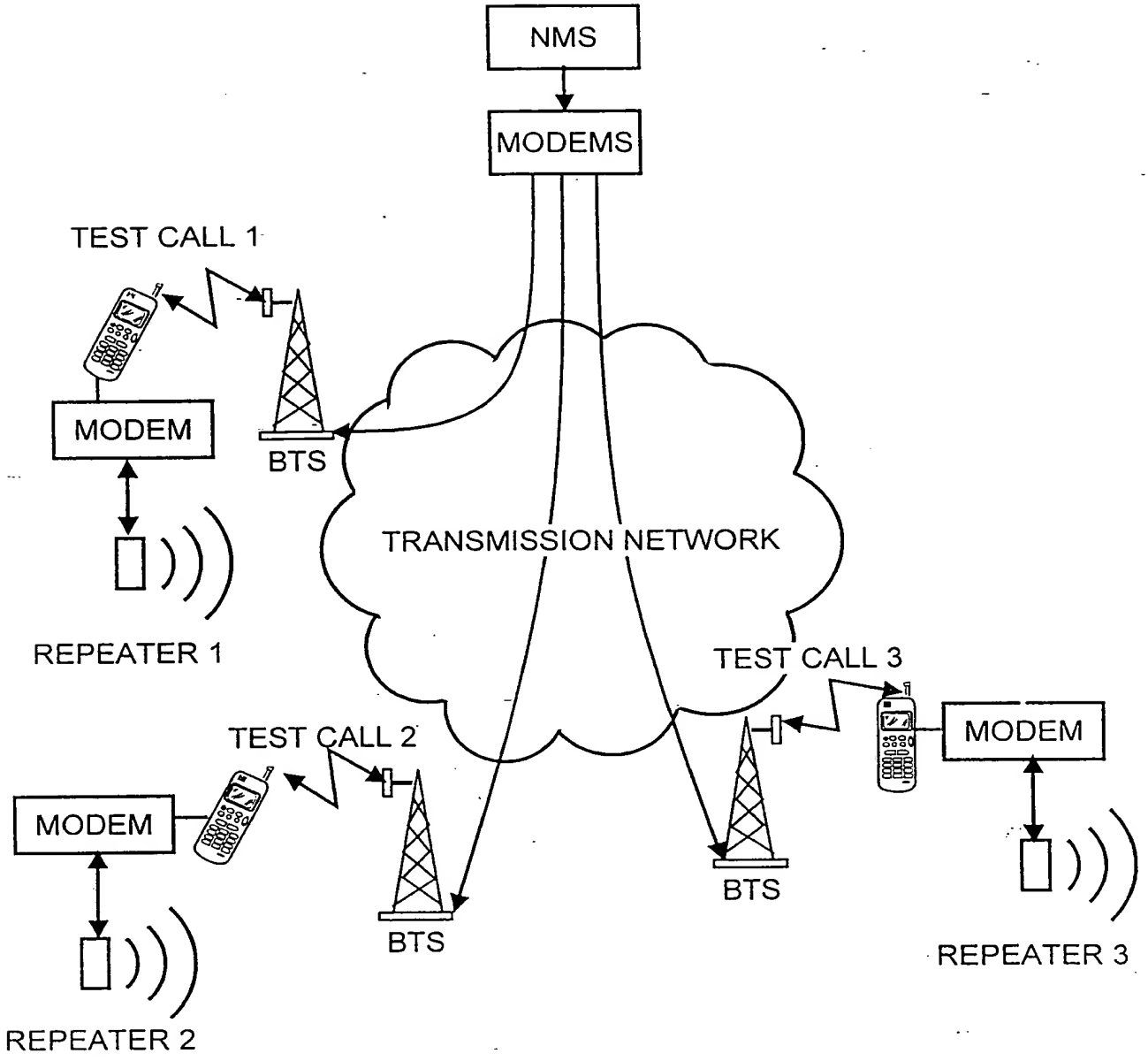

NMS
MODEMS
TEST CALL 1
MODEM
BTS
TRANSMISSION NETWORK
REPEATER 1
TEST CALL 3
MODEM
TEST CALL 2
MODEM
BTS
BTS
REPEATER 3
REPEATER 2

FIG. 4.

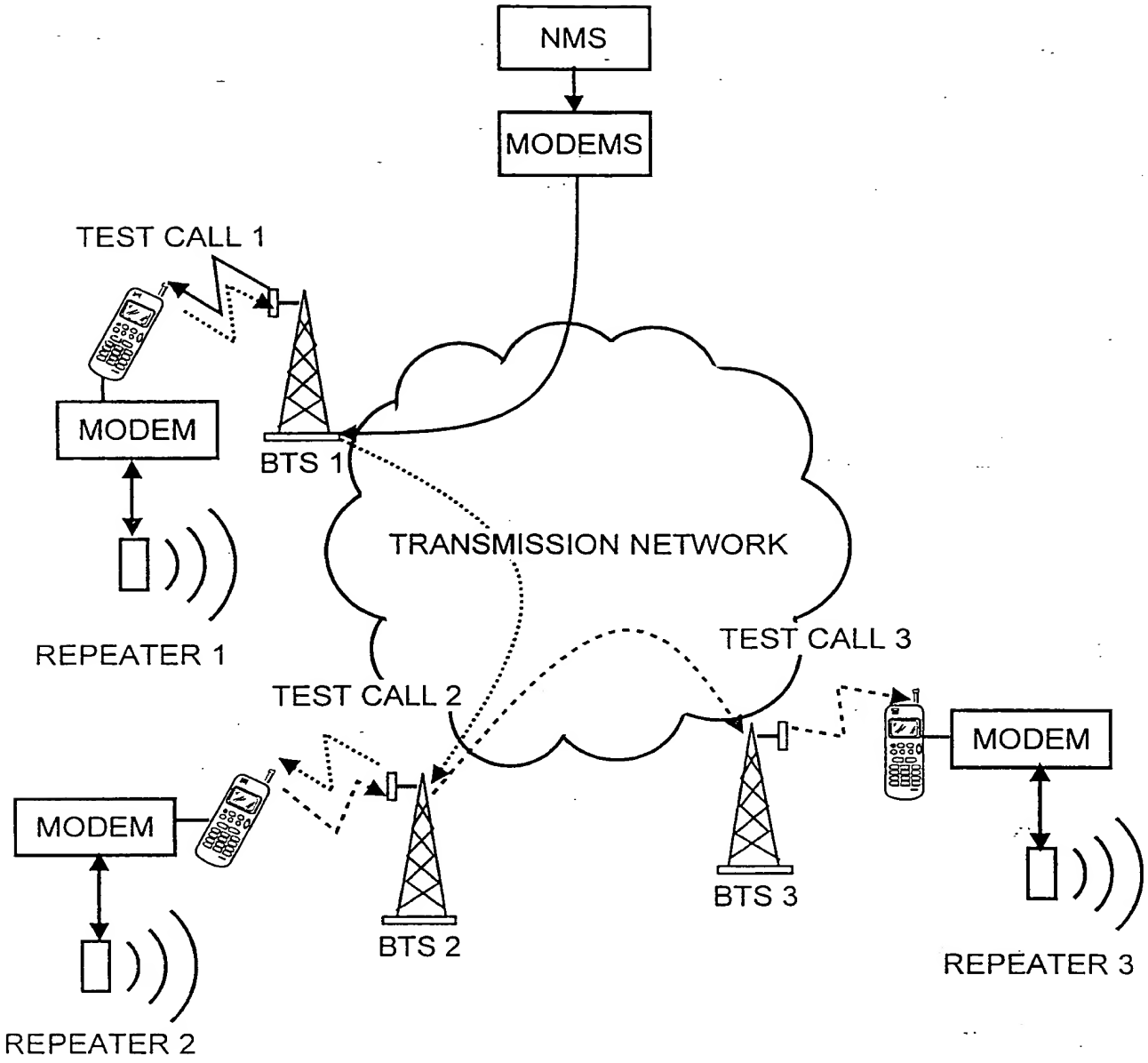

NMS
MODEMS
TEST CALL 1
MODEM
BTS 1
TRANSMISSION NETWORK
REPEATER 1
TEST CALL 2
TEST CALL 3
MODEM
MODEM
BTS 2
BTS 3
REPEATER 3
REPEATER 2

FIG. 5.

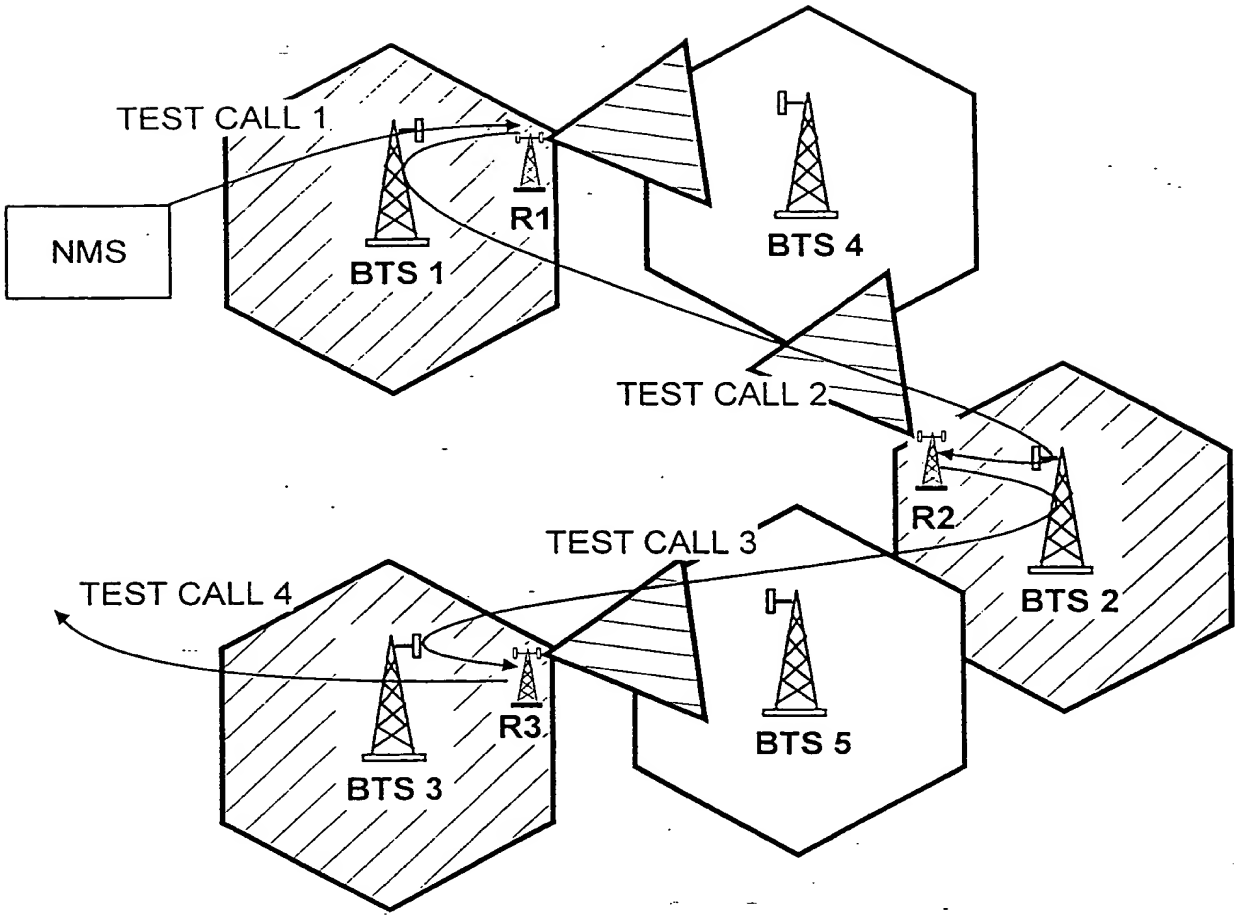

TEST CALL 1
NMS
R1
BTS 1
BTS 4
TEST CALL 2
R2
BTS 2
TEST CALL 3
TEST CALL 4
R3
BTS 3
BTS 5

FIG. 6.

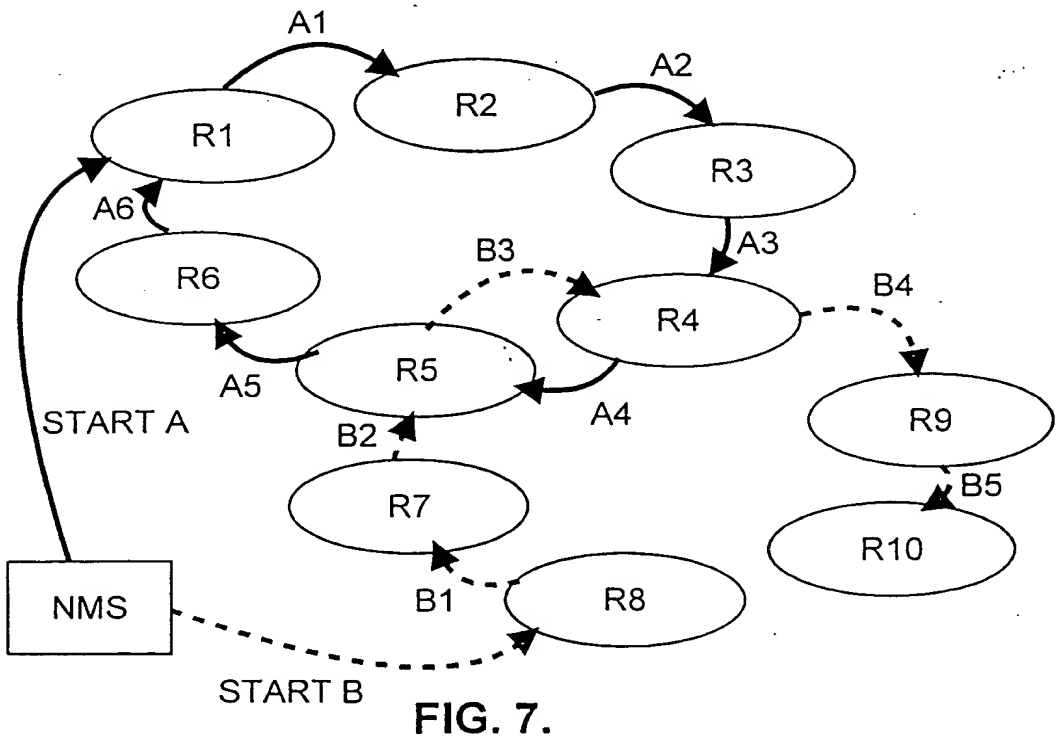

A1
R1
R2
A2
R3
A3
A6
R6
B3
R4
B4
A5
R5
A4
START A
B2
R9
B5
R7
R10
NMS
B1
R8
START B

FIG. 7.

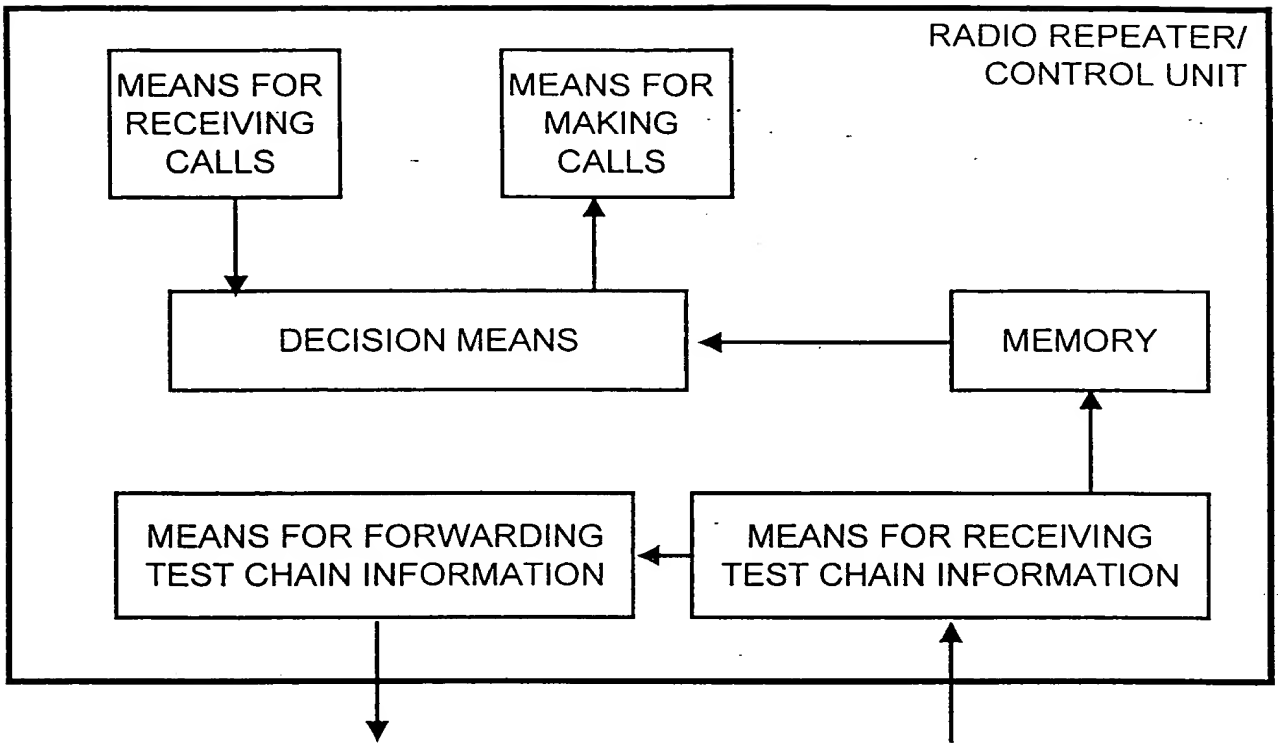

RADIO REPEATER/
CONTROL UNIT
MEANS FOR
RECEIVING
CALLS
MEANS FOR
MAKING
CALLS
DECISION MEANS
MEMORY
MEANS FOR FORWARDING
TEST CHAIN INFORMATION
MEANS FOR RECEIVING
TEST CHAIN INFORMATION

FIG. 8A.

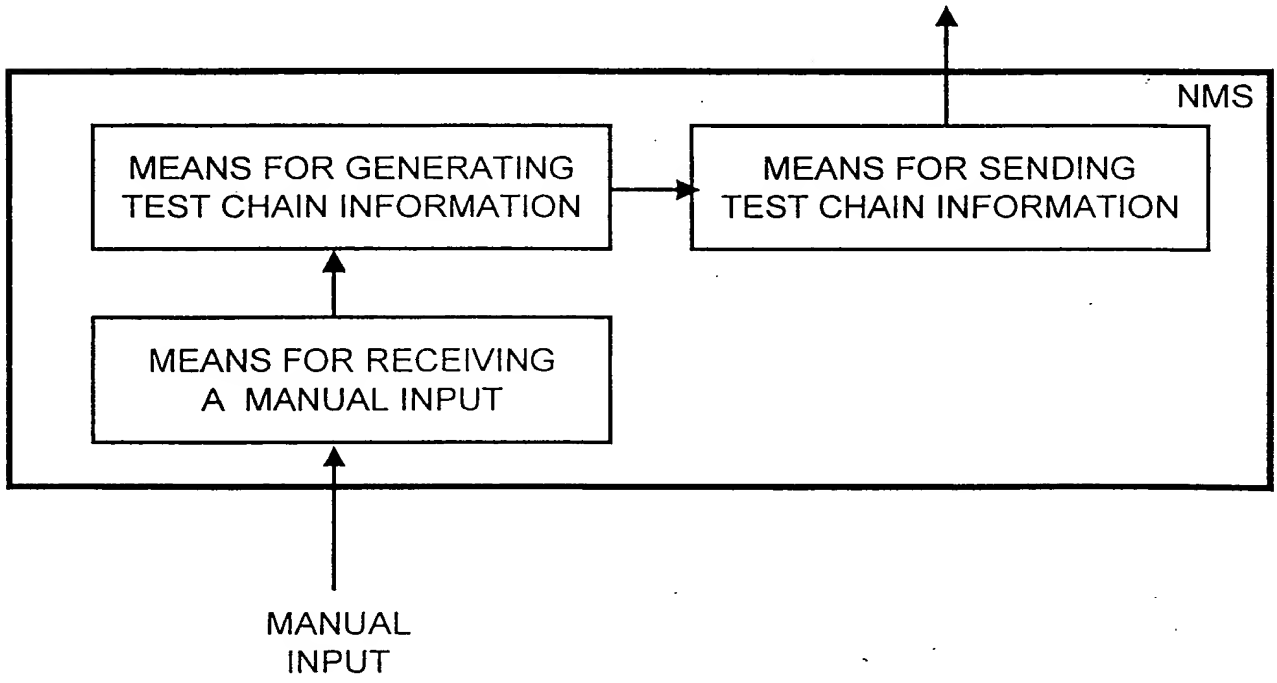

NMS
MEANS FOR GENERATING
TEST CHAIN INFORMATION
MEANS FOR SENDING
TEST CHAIN INFORMATION
MEANS FOR RECEIVING
A MANUAL INPUT
MANUAL
INPUT

FIG. 8B.